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An Inventory of Ocean-oriented Activities in the State of Maine, 1968

Maine Department of Economic Development

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AN INVENTORY OF OCEAN-ORIENTED ACTIVITIES
IN
THE STATE OF MAINE

Prepared By State Members
Of The
Maine Department of Economic Development
Augusta, Maine

October, 1968

James K. Keefe
Commissioner

AN INVENTORY OF OCEAN-ORIENTED ACTIVITIES

IN

THE STATE OF MAINE

The Department of Economic Development

The Department gratefully acknowledges
the efforts of Mr. Neil Rolde in the
preparation of this document.

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EDUCATION, RESEARCH, AND GOVERNMENTAL

EDUCATION, RESEARCH, AND GOVERNMENTAL

TRIGOM

The Research Institute of the Gulf of Maine

Representatives of eight Maine educational institutions have taken the first steps toward legally incorporating the Research Institute of the Gulf of Maine, an oceanographic research "consortium". It will be a nonprofit corporation dedicated to pooling the resources possessed by the participating schools. It is patterned somewhat on the Gulf Universities Research Corporation.

The seven colleges and one university concerned are: The University of Maine, Bates College, Bowdoin College, Colby College, Nason College, Southern Maine Vocational Technical Institute, Gorham State Teachers College, and St. Francis College.

Informal discussions among these institutions gave rise to a two-day Inter-Institutional Oceanographic Conference held at Bowdoin College on July 28-29, 1967. Representatives of the interested Maine schools attended a series of working meetings with representatives of ocean-oriented industries from throughout the United States and representatives of research institutes here and in Canada. Companies such as Grumman, Westinghouse, TRW Systems, Sanders Associates, General Electric, etc., sent research and development experts to the meeting and research institutes represented included Woods Hole Oceanographic Institute; U. S. Bureau of Commercial Fisheries Laboratories in Maryland, Massachusetts, Connecticut, and Maine; the Bedford Oceanographic Institution in Nova Scotia, and others. The conference was highlighted by the presence of Vice President Hubert H. Humphrey and Dr. Edward Wenk, Jr., Executive Director of the National

Council on Marine Sciences and Engineering, headed by Vice President Humphrey.

The essential thrust of the discussions held was that a cooperative program was the only way to meet effectively the challenge of oceanographic development in Maine. In particular, it was urged that one single physical plant be established where most of the work could be done and where there might emerge a true center for oceanographic activity. The point was also made that along with the development of a single physical entity, each institution should develop its own capabilities to the best of its abilities and to complement the programs of the central institute.

The oceanographers present stressed the need for basic research and graduate study. The industrial representatives and the oceanographers emphasized that Maine should direct its efforts to areas in which a unique contribution could be made. Specifically mentioned was the need for greater research and academic interest in fisheries and aquaculture. These were regarded as areas that would be natural for scientific undertakings off the coast of Maine.

A strong plea was made for the institutions to band together in a specifically organized corporate entity. To this end, before the conference concluded, a committee was appointed from among the educational institutions involved to draw up the draft of a document creating a legal entity for the purposes of joint oceanographic activity.

This work was given over to the University of Maine Law School. Legal documents were then drawn up, based to some extent on the structure of the Gulf Universities Corporation in

the Southeastern United States. These documents, forming a nonprofit corporation, are now being ratified by the various authorizing bodies of the different institutions. Dean David Fink of the University of Maine at Portland has been selected as the Interim President of the Board of Advisors of TRIGOM. The 103rd Legislature has appropriated \$50,000 for TRIGOM's use in its initial year of operation.

The capabilities and activities in ocean-oriented sciences of the participating institutions are as follows:

University of Maine - Orono, Walpole, Portland

Orono -- Competence and interest in ocean-oriented studies center on the Orono campus in the Departments of Zoology, Engineering, Botany, and Geology. Doctorates are currently awarded in zoology, plant science, and chemical engineering, among these disciplines. A doctoral program in oceanography has recently been approved.

Zoology - Dr. Kenneth W. Allen heads the Department of Zoology. His specific research interest lies in amino acid metabolism in aquatic animals. While a professor at U.C.L.A., Dr. Allen served as a consultant on the care of marine mammals at Marineland of the Pacific. Dr. John Dearborn has a special research interest in marine invertebrates, particularly the systematics and ecology of polar and deep-sea echinoderms. Dr. William Vallou, an endocrinologist, his interests in oceanographic applications of his specialty, such as metabolism studies of crustaceans. Dr. James Cook, whose research interests are in cell physiology, has served as a postdoctorate fellow at the Misaki Marine Station in Misaki, Japan. Dr. Paul Haefner is a

fisheries biologist and assistant leader of the Cooperative Fisheries Unit, sponsored by the U. S. Department of the Interior, now operating on specific research programs in the Penobscot estuary. Dr. Charles Major has done research on protein synthesis inhibition in hepatic regeneration and radiodine utilization in nemerteans. Dr. Marvin Meyer has research interests in invertebrate zoology and parasitology and is a member of the Smithsonian Institute's Oceanographic Sorting Center. Dr. Franklin Roberts has had research grants to work on the cytotaxonomy of northern cleipeiform fishes and a cytological study of the meiotic cycle in the herring, Cleipea harengus. Dr. Richard Hatch is a fisheries biologist and the leader of the locally-based Cooperative Fisheries Unit.

Engineering - Dr. Edward Bobalek is head of the Chemical Engineering Department. His research interests are in extraction processes and interfacial phenomena. He is currently the leader of a research team studying the Penobscot River system as a chemical reactor, through a \$72,000 grant from the U. S. Office of Water Resources Research (OWRR). Mechanical engineering Professor Richard C. Hill is Director of the Department of Industrial Cooperation. He has been in charge of a U. S. Government contract: "A Salinity and Temperature Control System for Marine Biological Research." Associate Professor Lowell Zabel, Chemical Engineering, has research interests in wire communications, feedback control systems, analog computers, and is participating in the Penobscot River chemical reactor project. Dr. Gordon Moskowitz, Mechanical Engineering, has research interests in underwater technology, physiology, and fiber physics. Associate Professor Walter Schneider, Mechanical Engineering, has an interest in oceanography concerned with the design of mechanical equipment and the dynamics

of ships and other floating submerged objects. Associate Professor Karl Webster, Mechanical Engineering, is working on the Penobscot project also. Professor Walter Turner, Electrical Engineering, is participating in the study of the Penobscot River. Dr. Edmund Sheppard, Electrical Engineering, has served as a consultant on communications systems with Sanders Associates and has research experience in communication theory and medical electronics. Associate Professor Carleton Brown, Electrical Engineering, has worked with Sanders Associates in the field of biomedical electronics.

Botany - Dr. Charles Richards is a Professor of Botany and has done work on the seaweeds of the Maine coast. Assistant Professor Robert Vadas is an algologist. A principal research activity of his had been the underlying physical and ecological factors responsible for the dominance of agarum in many areas of the San Juan Archipelago.

Geology - Dr. Joseph Trefethen, currently at the University of Maine in Portland, formerly at Orono, and State Geologist, collaborated with Sea and Shore Fisheries Department from 1948 to 1956, in graduate student projects and financed and supervised the geologists working on cooperative biological-geological investigations with biologists employed and supervised by Sea and Shore Fisheries. Through his efforts and those of the research personnel in the Sea and Shore Fisheries Department, collaborative assistance was obtained from Dr. Wilmont Bradley, Chief Geologist, U. S. Geological Survey, and the Bureau of Commercial Fisheries and intensive geological-biological research investigations were carried on in selected coastal areas. This initiated collaborative efforts and team research elsewhere in the country in the intertidal and subtidal areas. Several technical papers were published on these investigations in addition to graduate theses and departmental reports.

Other - Matthew Highlands, head of the Food Science Technology Program, has worked extensively with the Maine Department of Sea and Shore Fisheries on problems of preserving lobster meat and related studies.

Oceanography Doctorate - During 1967, approval was given to the initiation of a doctoral program at the University of Maine in oceanography. The program, for the present, will be restricted to biological oceanography, but it is expected that a geological phase will be added as soon as personnel can be hired. Students are now being accepted for the bio-oceanography doctoral program. The Departments of Bacteriology, Biochemistry, Botany and Plant Pathology and Zoology are involved in the doctoral program. Requirements of the oceanography curriculum are in addition to those of the departments. All students must take Zo 170, Introduction to Oceanography. All students must spend a minimum of one summer or the equivalent at a marine station while engaged in an approved marine activity. Students must accumulate a minimum of 20 days experience aboard an oceanographic research vessel. Students must prepare an acceptable thesis based upon original, independent research. As long as there is no Department of Oceanography at the University, the doctoral program will be administered by an Oceanographic Steering Committee that shall consist of only graduate faculty members actively engaged in marine work.

Ongoing Research - Study of the Penobscot River System as a Chemical Reactor--With Dr. Edward Bobalek as Principal Investigator, this multi-disciplined project, involving various facets of engineering, seeks to make a mathematical model of the Penobscot River, which can then be readjusted for changes such as pollutants, temperature, and corrective processes. Thus, the results of measures undertaken

to clear up pollution in the river can be tested mathematically before actually used. This would avert mistakes in attempting corrective measures. The Penobscot River, a typical paper making river, is considered representative of many other rivers in the State of Maine and other states. Under a grant of \$72,000 from the U. S. Office of Water Resources Research (OWRR) work is already underway on this project. Two monitoring, instrument carrying buoys are currently being built in Orono. They were designed by two members of the Engineering Department, Karl Webster and Lowell Zabel. Local craftsmen hope to complete these buoys for placement in the river before the summer of 1968. This work will later be coordinated with that projected by ESSA in its flushing prediction studies of the Penobscot.

Other ongoing research projects are in the Department of Zoology, now located in its new million and a half dollar building on the Orono campus. This specially designed structure, built on a courtyard principal so that all rooms have exterior light, has 65,000 square feet of floor space, of which more than 50% is devoted to research. It has its own fresh water circulating system for salmon and trout, an electromicroscope, air-conditioned animal laboratories and facilities for handling isotopes.

Current research projects include studies on glucose metabolism in the crab, Cancer borealis, uptake of inorganic sulphate by the blue mussel, Mytilus edulis, systematics problems in starfish, growth and distribution of the green sea urchin, Stronglycentrotus droenbachiensis, uptake of radioactive iodine in marine worms and examination of a family of marine snails.

Fisheries Cooperative Unit - Scientists working from Orono as part of the Fisheries Cooperative Unit, funded by the Bureau of

Sport Fisheries and Wildlife of the U. S. Department of the Interior, have been working on various research problems. Hydrographic studies of the Penobscot River estuary have been made, including environmental monitoring of 30 miles of estuary from Bangor to Searsport, for current, temperature, and for investigations of the salinity tolerance of the sand shrimp, Crangon septemspinosus. The National Science Foundation has supported research into the distribution of gammaridea (amphipoda) in the Penobscot estuary. Improvement of the quality of hatchery produced Atlantic salmon smolts for increased estuarine survival is another subject of investigation, as is a study of the sources of the striped bass populations exploited in Maine waters.

Atlantic Sea-run Salmon Commission - The Commission is composed of the Commissioners of Inland Fisheries and Game and Sea and Shore Fisheries and a person appointed by the Governor. The budget of the Commission supports a biological program and a Chief of Fisheries Research and Management. This position and one other research position are currently vacant. Programs involve tagging and stocking hatchery fish and sampling salmon rivers for native stocks.

Water Resources Center - Under the direction of Warren Wiesman, a Federally-financed Water Resources Center has been set up on the Orono campus by the U. S. Office of Water Resources Research (OWRR). Its duties are to assist research into water pollution problems in Maine. One grant has already been given to the University of Maine's Darling Center for investigations of the ecological effects of pollution in three Maine rivers that have varying degrees of pollution, from heavy to nonexistent. Other research projects of the Center, which has been in operation for 36 months, include basic water research on New England soils, waste water disposal, effect of nitrification, removal of viruses and water conservation in food processing plants.

Sea Grant Projects = Several ideas for Sea Grant projects have been proposed to the Sea Grant Office in the National Science

Foundation although no completed applications have yet been forwarded from the Orono campus. An interdisciplinary venture would be the contemplated study in cooperation with the Central Maine Power Co. in monitoring waters of Montsweag Bay before and after the installation of the giant Maine Yankee Atomic power plant at Wiscasset. The object of this study would be to determine the effect of thermal pollution on marine organisms. Drs. David Dean and Bernard McAlice from the Darling Center, Dr. Robert Vadas from Orono, and Dr. Darrell Pratt, head of the Department of Bacteriology at Orono, would participate.

Other Sea Grant ideas proposed are for the determination of the use of marine algae as animal feed and feasibility of constructing small workboats out of paper.

Darling Center - Walpole - The Ira C. Darling Center at Walpole near the Town of Damariscotta is to serve the University of Maine for marine research and teaching. It will figure prominently in the doctoral program. Currently, facilities include 3,000 square feet of laboratory and office space, a dormitory for 22, two seminar rooms, a library of 700 books and 1,000 periodicals, several thousand reprints, and a microfilm reader. Vessels are a 43-foot schooner and 3 smaller boats. There is a small pier and a building with floating seawater. A large assortment of equipment is owned by the Center.

Ongoing research programs include (A.) life history of polychaetous annalids, a National Science Foundation grant, (B.) water quality - invertebrate relationships in estuaries, funded by the Water Resources Center in Orono, a study in the Sheepscot, Damariscotta and Penobscot Rivers, (C.) invertebrate-sediment relationships, (D.) systematics and life histories of east coast

polydoriids, (E.) hydrography and planktology of the Damariscotta River, (F.) nereid ecology and development.

Monthly seminars in marine biology are held at the Center. During the summer of 1967, a group of students from Bates College studied and did field work at the Center.

Approval of a public referendum in 1967 voted the sum of \$150,000 for the building of permanent and expanded laboratory facilities at the Darling Center. These funds are being used to construct a large pier and to prepare a Master Plan for facilities development through 1980. Architects, Jackson and Moreland of Boston have the final report at the printers. The projected cost for development at the Center through 1980 is 7.3 million dollars.

Director of the Darling Center is Dr. David Dean, whose research interests are centered on polychaetous annelids and on benthic studies. Recent additions to the staff are Dr. Bernard J. McAlice, whose research interests are in plankton ecology and ecosystem dynamics, and Research Associate Michael Mazurkiewicz, whose research interests are in ecology of the benthos, larval development of polychaetes, and invertebrate pathology. Dr. Loyd Kenneth Fink, Jr., a geophysicist, joins the staff January 1, 1969. Three doctoral students are now working fulltime at the Center and several master's and doctoral candidates use the Center's facilities for their research. The Center is currently seeking three more oceanographers to add to its staff. Temporary buildings will be leased and moved to the site to provide laboratory and office space for new staff members until the next phase of new construction is completed.

This summer, Dr. David Dean, along with Dr. John Dearborn and graduate students Robert Bullock and James A. Blake, will journey to the Labrador Sea aboard the newly constructed oceanographic research

vessel Hero, built in Maine by the U. S. Office of Antarctic Research within the National Science Foundation. Studies will be made of bottom animal populations and their reproduction in deep water from the Labrador Sea down through the Gulf of Maine to Boston.

University of Maine - Portland - An 18-acre campus contains two major classroom-office buildings. Current facilities include two biology labs, one chemistry lab, and one physics lab. A new science building now under construction will contain four biology labs and other special science facilities, plus a computer center. A new graduate education building, approved by the voters, will, it is contemplated, house the administrative headquarters for TRIGOM. Dean David Fink of U.M.P. is the interim President of the Board of Advisors of TRIGOM. Programs at U.M.P. include an undergraduate major in biological sciences, a two-year sequence in chemistry and physics, first year of geology and a Master's Degree in engineering to begin in the Spring semester, 1968. Dr. Haig Najarian, Associate Professor of Biology, has publications in invertebrate zoology, helminthology, protozoology, chemotherapy and microbiology.

University of Maine Law School - Portland - A Sea Grant Project has been submitted to the Sea Grant Office in the National Science Foundation by the University of Maine Law School. The project is for a survey of Maine law affecting marine development and determining the scientific validity and economic impact of such law. This was the first Sea Grant Project application submitted by a Maine institution. Associate Professor David J. Halperin is to be the Program Manager. The work proposed is to be done in cooperation with scientific specialists and economics specialists throughout the State, as well as with certain related activities out of State,

notably a compilation of laws being made by the Marine Environment Legal Research Project of New York University Law Center. A comprehensive water study to be funded by the U. S. Office of Water Resources Research is being sought simultaneously with this Sea Grant Project by the University of Maine Law School. Phase 1 of the Sea Grant Project will consist of a survey of all Maine law affecting marine resources. Phase 2 will consist of consultation with specified experts in nonlegal disciplines: marine biology, geology, economics, food technology, and marketing. Information gathered will be integrated with the legal provisions concerned. The study will seek to identify what are thought to be major gaps in existing Maine laws, to provide data for proposed legislation, to furnish a foundation for seminars on legal aspects of marine resource development and to furnish the basis for law school curricular developments.

Bates College - Lewiston - The following courses regularly offered at Bates College are considered useful in marine studies: Ecology 266, Invertebrate Zoology 211, Microbiology 214, Botany 222. In addition, a special course offered during the short term (May & June), Environment 223, is a "study of the properties of the marine environment in relation to plant and animal life. Emphasis is on the chemical, physical, and biological factors determining the productivity of estuarine and coastal areas". This course requires extensive field work and part-time residence at the Darling Center. During the short term, Bates students have use of the facilities at the Darling Center and at the University of Puerto Rico at Marquay Island, Parquera. Assistant Professor Harold E. Hackett, whose research interests are marine ecology and marine botany, conducted the course that was held for Bates students at the Darling Center.

Bowdoin College - Brunswick - Bowdoin College has two scientific stations capable of use for marine studies. The Bowdoin College Marine Station at Cundy's Harbor, Maine, is a two-acre site, containing one trailer laboratory, a dock, a 15-foot boat and several skiffs. The area is used as a basic research and collecting station for marine organisms and ecological studies. The Bowdoin College Scientific station is at Kent Island, New Brunswick, Canada. The island has a caretaker's house, laboratory and living quarters, small house, skiffs - largely used for summer ornithological research, but the island has other possibilities.

Bowdoin has long had an interest in oceanography. Former President, Dr. James Stacy Coles, is a Trustee and former member of the Executive Committee of the Woods Hole Oceanographic Institution. The current Dean of Faculty, Economics Professor James A. Storer has served as Assistant to the Director for Economics, U. S. Bureau of Commercial Fisheries, and he has recently been appointed to the Department of the Interior's Advisory Committee on Marine Resource Development.

For many summers, Bowdoin has conducted a course of marine biology training for secondary school teachers. It is sponsored and supported by the National Science Foundation.

Marine-oriented teaching personnel at Bowdoin are: Dr. Alton H. Gustafson, Chairman of the Biology Department, whose research interests are in marine ecology, especially inter-tidal. He has studied at Woods Hole off and on since 1932 and at the Miami Marine Station. He has done research on quahogs for the Maine Department of Sea and Shore Fisheries. Every summer since 1959, he has conducted the Summer Institute in Marine Biology; Dr. James Moulton, whose research interests are chiefly on sound production and hearing

in marine fishes and gold fish and neurophysiology, cytology and physiology of cold-blooded vertebrates. He participated in oceanographic cruises of Atlantis II and Chain and Anton Brun. He has done research on quahogs and has studied embryology at Woods Hole; Dr. Robert Knowlton, whose research interests are physiological ecology of larval decapod crustacea and sound production in decapod crustacea and who has been a research assistant at the Bermuda Biological Station and the University of North Carolina Institute of Marine Sciences; Dr. Charles E. Huntington, whose research interests are in avian ecology, especially the dynamics of sea birds; Harold Arndt, teaching fellow who acted as a marine biologist for the Town of Brunswick Marine Resources Survey and whose research interests are in mass aquaculturing of shellfish and phytoplankton in salt ponds and semi-closed marine environments and the effects of heated water on marine environments.

Colby College - Waterville - Colby College has standard biological laboratories with associated equipment, a small boat and limnological equipment. No ongoing major programs are directly related to the marine sciences. Two research projects of a peripheral nature are in progress in the Biology Department. Dr. Bruce Fowles is studying the reproductive physiology in aquatic fungi, with emphasis on fresh-water forms, and Dr. Ronald B. Davis is studying lake sediments relative to problems of pollen fossilization and stratigraphy. Dr. Davis also has run a study program in marine biology for 20 students at Pigeon Key near Miami, Florida. Dr. Fowles has participated in a research expedition on the vessel Te Vega out of Stanford University, operating in the South Pacific. Professor Donaldson Koons, Department of Geology, has a strong interest in shore line morphology. He has observed and studied

wave action and is responsible for placing students on a research vessel at Woods Hole. Dr. Allan Scott, Chairman of the Department of Biology, has been a member of the Corporation of the Marine Biological Laboratory and of the Bermuda Biological Laboratory for many years. He has done cytological research in marine animals at Woods Hole, Naples, Italy, and the Corona del Mar Marine Station of the California Institute of Technology.

Gorham State Teachers College - Gorham - Various personnel at Gorham State Teachers College have an interest in marine sciences. Assistant Professor Robert N. Miller, Chairman of the Department of Life Sciences, is a geologist with research interests in structural geology. Assistant Professor George Barker is a marine algologist who is currently preparing a publication on marine algae. His research interests include the natural history of marine algae and photomicrographic work with marine algae. Assistant Professor Parnell Hare has been on leave to study oceanography at the University of Washington. He has been an instructor in meteorology. Associate Professor Maurice Whitten is a chemist and qualified to do analytical work in chemistry. Assistant Professor Joseph Vaughan, who is interested in marine biology, has been President of the Maine Biologists Association.

Nasson College - Springvale - The principal facility at Nasson College for marine study is a mobile laboratory and field station built into a war surplus 30-foot by 8-foot trailer. It contains pumps and hoses for setting up circulating aquaria, has its own water tanks and generators. It has been used on field trips up and down the Maine coast and has participated in a biological inventory of York County. The college is now in the process of having a 20-foot catamaran built. This summer, the

college will broaden its usual marine biology course to include other facets of biological study, including the effect of water pollution.

Personnel at Nasson include: Dr. Gordon Johnston, who has been a member of the Bi-State Commission on Oceanography and Acting Executive Director of TRIGOM, and whose interests are in crop ecology and hydrobiology. Assistant Professor Robert Ciullo, whose research interests are vertebrate histology and histochemistry; Dr. Claude Gilmore, whose interests are in marine invertebrate zoology, taxonomy, morphology and ecology of marine polychaetous annelids, invertebrate embryology, and marine algology. Assistant Professor William Fitzgerald, Chemistry, has done chemical analysis of sea water, salinity, dissolved oxygen, etc., Dr. Peter Jackson, Chemistry, has worked on water pollution problems.

Southern Maine Vocational Technical Institute (SMVTI) - South Portland - The Marine Technology program at SMVTI is known throughout the country. Some 65 students currently receive training in the operation of oceanographic vessels and equipment with ancillary training in marine sciences. These students, upon graduation, are hired by all of the major oceanographic firms. Two large vessels are used in the program, the 134-foot Aqualab, recently refurbished, and the 135-foot Phykos, on loan from the Smithsonian Institute for a joint program of research, wherein SMVTI students attend offshore research stations and collect data for the Smithsonian. Such data includes salinity content, oxygen content, and direction and velocity of currents with an accurate reading of latitude and longitude. Biological specimens will also be collected for the Smithsonian. In connection with the U. S. Navy Hydrographic Office, SMVTI has a contract to maintain 26 ocean

stations in Casco Bay. Four times a year, the vessel visits these stations to determine water temperature by use of a B.T., obtaining Nansen bottle samples and determining salinity content, oxygen content, and direction and velocity of the current. Discontinued with the inoperation of the Aqualab, this program is about to be resumed.

SMVTI is in the process of acquiring from the federal General Services Administration a former fuel depot on Long Island, Casco Bay, that will serve as a year round marine station, available to all Maine institutions and those from out of state, as well. The Long Island facility has some 13 buildings, more than a hundred acres, dock, running sea water, and a repair shed for boats up to 200 feet. In addition, the 30-acre campus of SMVTI, with science building, marine biology lab, engineering shop, deck shop, pier, and dormitories is available to outside schools for use on a rental basis during the summer. For further information, address inquiries to Arthur Smith, Principal of SMVTI.

Personnel engaged in marine activities at SMVTI include Captain George Hupper, Chairman of the Marine Technology Department, a veteran of 25 years service in the Coast Guard and Master or Commanding Officer of 11 vessels; Tapan Banerjee, Instructor of Marine Biology and Oceanography, whose research activities include estuarine work in the Hudson River, New York; Tomales Bay, California; and the James River, Virginia; and Chesapeake Bay and fishing research in the North Sea. His research interests include zooplankton research, benthic ecology, and fish embryology. Edward Foss, Instructor in Marine Biology and Oceanography, has recently returned from an oceanographic cruise in the Pacific.

Sea Grant Project - SMVTI has submitted to the Sea Grant Program

office in the National Science Foundation a proposal for expanding their current activities to include an Applied Marine Biology-Oceanography course that would accept some 25 students, while the present Marine Technology program would be expanded to 80 freshmen and 45 seniors. Both would be Associate Degree courses. The Applied Marine Biology-Oceanography course would include technical instruction in aspects of marine aquaculture.

St. Francis College - Biddeford - St. Francis College is located on the Saco River and Biddeford Pool. There are two biology laboratories, one a marine laboratory with constant temperature and a 500-gallon aquarium, the other a senior and staff research laboratory. There are two chemistry laboratories, one balance room, one instrumentation room (infra-red spectrophotometer, radiation instruments, gas chromatograph, etc.), one physics lab, and a library of 30,000 volumes. A major in biology is offered, including General Biology, Comparative Embryology and Anatomy of Vertebrate, Invertebrate Zoology, General Physiology, Parasitology, Ecology and Microtechnique, all of which apply directly to the broad area of marine studies.

Personnel include Dr. Lewis Aldrich, whose research interests are in parasitology. He has written several papers on marine parasites for the Journal of Parasitology. Dr. Margaret Simpson has studied at Woods Hole and has done work on the polychaeta Glycera dibranchiata.

Maine Marine Science Stipend Program

Maine Department of Economic Development

Augusta

Inaugurated in 1968, the Maine Marine Science Stipend Program within the Maine Department of Economic Development's newly formed Division of Science and Technology follows the pattern of an earlier

and successfully continuing research grant-in-aid program of the Maine Geological Survey.

Two types of stipend are granted. Summer researchers will receive a maximum of \$200 a week for a period of up to 16 weeks. A year-round stipend, paid on a monthly basis, is presently being offered only to researchers affiliated with Maine institutions. All stipends, in effect, are outright grants. Stipends are renewable each year until the completion of a project.

Any pre- or post-doctoral researcher in any field of marine science may apply for a stipend. Group research is encouraged. A joint project, for example, involving a faculty member and his PhD. candidate students would be eligible.

All research projects must be ventured on the near shore and shelf environments of the Gulf of Maine waters bordering the Maine coast.

Research results will be published in Bulletin form. Robert G. Doyle, Director of the Division of Science and Technology, Maine Department of Economic Development, State Office Building, Augusta, Maine, is in charge of the program.

Maine Department of Sea and Shore Fisheries

Augusta - Boothbay Harbor

The Maine Department of Sea and Shore Fisheries, under the direction of Commissioner Ronald Green, is the oldest Marine Research Agency in Maine and is one of two organizations with more than 20 years experience in ocean and estuarine research. (The other being U. S. Bureau of Commercial Fisheries.) This state agency employs approximately 70 persons, with responsibility for conducting research, marketing, management, and extension activities in regard to

renewable marine resources and for enforcing all laws relating to marine resources.

The Department is headquartered in the State Office Building in Augusta, Maine. Research is centered, although not exclusively confined, to the marine laboratory at McKown Point, Boothbay Harbor. This facility is located next door to the marine station of the U. S. Bureau of Commercial Fisheries. Cooperation between the two units is strong. Robert L. Dow, noted lobster expert, is Director of Marine Research for the Department and has published, since World War II, many papers on methods of measuring and predicting abundance fluctuations of several marine species, with special emphasis on environmental factors. Dana E. Wallace, Assistant Research Director, has concentrated on shellfish management work, pollution problems, fisheries education and extension type activities. Phillip Goggins, Laboratory Director at Boothbay Harbor, has publications and nearly 20 years of experience in shellfish sanitation, depuration and pollution, and in lobster biology, ecology and diseases. The total research staff consists of 14 marine scientists, 7 technicians and specialists and the director of marine research.

The marine laboratory contains a fully equipped sea water system with modern controls for temperatures and salinities. There is also a bacteriology laboratory, capable of monitoring bacteria in water and shellfish in accordance with U. S. Public Health standards. A gas chromatograph gives wide capabilities for analysis work including monitoring of pesticide residues.

On August 11, 1967, a fire extensively damaged the top floors of the laboratory. Temporary repair work and some modernization has been accomplished. A modern laboratory is planned for a nearby

site with construction of a portion due to commence in the fall of 1968. This will substantially increase the facilities of the State on McKown Point.

Vessels include two diesel-powered craft of 63 feet and 42 feet and two 16-foot aluminum boats. The Department also has 32 other boats, ranging in size from 11 to 20 feet, used for management, enforcement and the gathering of statistics.

The Department owns, maintains and operates a Cessna 180 float plane, as well as eight vehicles.

Research Projects

The Department has carried out numerous research projects since 1946. Recent expansion of programs has been financed wholly or in part by various Federal agencies, including the U. S. Bureau of Commercial Fisheries and Wildlife in the U. S. Department of the Interior, the U. S. Public Health Service, the Economic Development Administration in the U. S. Department of Commerce, and the U. S. Army Corps of Engineers. Research grants have been made to the Department by private companies to aid specific projects.

Lobster Research - Several matching grant programs of lobster research are being conducted under Public Law 88-309. (A.) Random sampling of lobster catch data has been carried out and it has been proposed to computerize this data. Data collected during the first year of the project is being analyzed to assess lobster populations. Entries are sex, length, weight, number of traps fished, bait used, time and location. Goals are to improve the precision of estimates, particularly population parameters, such as natural and fishing mortalities along the entire Maine coast. (B.) Related research into the effect of thermal discharge is aimed at eventually harnessing heated water for the experiments in the breeding and farm-raising of

lobsters. A promise of funds for accomplishing the initial stage of this latter research has been forthcoming from the Federal Water Pollution Control Administration. Current investigations, supported under Public Law 88-309, consist of a study of the variability of the physical environment and the survival of native organisms, both planktonic and adult, under the influence of the heated water discharge. These studies are being conducted at the Central Maine Power Company's electric plant at Cousins Island, Yarmouth. The company has provided a twelve-channel device for recording temperatures. To date, only the first phase of this ambitious undertaking has been accomplished. Cover, in the form of cement blocks and quarried stone, has been laid down to create shelter requirements for recruiting a population of lobsters. Later stages will consist of constructing equipment and devising engineering techniques for the mixing of different temperature waters, development of encapsulating shelters for lobsters to provide protection from predators and for better control of temperatures, experiments in use of sewer treatment effluent as a base for feeding material, construction of an underwater laboratory, and application of the experiments on a larger scale. The Ford Foundation has shown interest in aiding with some of the later stages.

The state-federal cooperative lobster program of biological and environmental research is lead by James C. Thomas, joining Sea and Shore Fisheries after fisheries research in New Jersey, California and Bureau of Commercial Fisheries at Boothbay Harbor on the offshore lobster population. As well as biological training, he has done advanced work in statistics and computer programming.

Shrimp Research - Investigations of two species of northern shrimp, Pandalus borealis, already being utilized commercially in

Maine, and Pandalus montagui, which has commercial possibilities, are being supported under Public Law 88-309. A converted 56-foot sardine carrier, Draggin' Lady, is being used in these studies, which are aimed at determining the geographical distributions, the life histories, the abundance and the governing ecological factors for the two species.

To develop the ability to predict accurately, seasonal and geographical supply is a major objective of the research.

Shrimp research is being conducted by Spencer Apollônio who, between 1956 and 1963 was engaged as oceanography and arctic ecology project leader for the Arctic Institute of North America making oceanographic, marine biological, and limnological observations during the Devon Island Expedition. He is assisted by Earl Dunton.

Marine Worm Research - The sand worm, Nereis virens, and the blood worm, Glycera dibranchiata, form the basis for an important Maine business - selling marine worms for bait. More than a million dollars annually is grossed. Research, also under Public Law 88-309, is concerned with gathering ecological information for more precise forecasts of population and management of the fishery and development of commercial handling, storing, and packaging techniques.

Project leader is Edwin Creaser, who joined the research team after graduate work and field experience in Delaware. His assistants are Clement Walton and David Clifford.

Shellfish Management Research - In this state-financed program, the Department works with coastal towns, diggers and dealers in developing shellfish management programs, particularly in regard to the soft shell clam, Mya arenaria. Thirty-eight communities now regulate this fishery in cooperation with the Department, which conducts surveys of populations and monitors pollution conditions.

In 1963 a technical assistance grant from the Economic Development Administration was arranged by Kenneth Curtis and has made possible a study and development of techniques for establishing ultraviolet light clam depuration facilities. Two depuration plants have already been built in Maine, at Phippsburg, Seafair, Inc., and at Stockton Springs, the Penobscot Bay Shellfish Association.

Shellfish are the primary concern of the area Marine Resources Scientists. Malcolm Richards has carried on research work and has publications in Shellfish management and shellfish sanitation surveillance. He is responsible for the coastal area from the Penobscot River to the St. Croix.

Paul Venno is responsible for cooperative shellfish work involving extensive studies on shellfish population and harvesting techniques. His area is the mid-coast area from the Penobscot River to the Kennebec River.

Bradford Sterl covers the coast from the Kennebec River to the Piscataqua with special emphasis on shellfish depuration, marine marshlands and oyster farming research.

Anadromous Fish Research - Public Law 89-304 has provided funds for state-federal matching programs for research fishway construction, stream improvement, relating to anadromous fisheries. Data is being collected to establish a priority system of stream improvement and fishway construction. Indications are that the current annual fishery for the alewife, Alosa pseudoharengus, of 3 million pounds can be increased to 16 million pounds and further improved to 50 million pounds with proper management and access to spawning grounds.

Another project will deal with evaluation and utilization of areas utilized by striped bass and smelt and the importance of

these species to the marine fishery economy of Maine.

Fred Baird is project leader and a member of the research team for more than twenty years with major emphasis on biological research and publications on anadromous fisheries and other fish and shellfish. He is assisted by Lewis Flagg.

Commercial Fisheries Estuarine Resources Research - This is a program to develop commercial fisheries for unutilized and underutilized marine plant and animal resources. In cooperation with several Maine firms processing Irish moss, Chondrus crispus, data is being collected on the location and extent of the crop, potential for a longer harvesting season and the development and testing of mechanical harvesting machinery. SCUBA diving is being used in these studies. Mussel and oyster resource possibilities are also being investigated. A cooperative program with the University of New Hampshire seeks to develop a technique of raft culture and an industry in seed and adult oysters in Great Bay, New Hampshire, and the Piscataqua River in Maine and New Hampshire.

The project leader is Frank W. Ricker, with a speciality of marine plant biology and ecology. He is assisted by Frank Spencer, a Marine Resources Specialist, who is a professional diver and is in charge of the SCUBA diving team.

Extension Service - Another program under Public Law 88-309, the Maine Marine Fisheries Extension Service is the first of its kind in the nation. It is based on the model of the well-known agricultural extension service of the U. S. Department of Agriculture and certain Canadian experiences in fisheries extension. Committees have been formed in coastal counties and their regularly scheduled meetings are coordinated by a State Committee. Presentations of material of interest and aid to fishermen are carried on at all

meetings.

Donald M. Harriman, a Marine Resources Scientist for more than 20 years who acted as area biologist and investigator with publications on lobsters and shellfish, is now in charge of the Extension Program. He is assisted by Paul Fournier.

Education Program - Department personnel have worked closely with secondary school teachers in developing fisheries education programs since 1948. Education units, consisting of texts, questions, and answers, laboratory experiments and bibliographies concerning common Maine species of marine life have been prepared by the Department. From 1957 to 1964, until his death, Alfred (Ben) Fortier, a noted educator with 30 years science teaching experience, spent full time assisting schools in the developing of marine oriented projects and studies. Area biologists now attempt to work this service into their busy schedules.

Pesticide Monitoring Program - Specimens are collected monthly from stations that sample the drainage systems of approximately two-thirds of Maine. The project is funded by the U. S. Bureau of Commercial Fisheries as part of a pesticide monitoring program embracing all coasts of the U. S.

John Hurst, in charge of pollution studies at Boothbay Harbor, has carried on research on shellfish sanitation and depuration, lobster research, involving industry problems and pollution studies including pesticide monitoring. He has taken specialized training in the use of the gas chromatograph.

Shellfish Certification Program - The Shellfish certification program is a major responsibility. The purpose of this program is to assure the consuming public that the shellfish which is purchased is of a wholesome quality. In order for clams either

shucked or in the shell to be sold out of state (interstate), they must come from unpolluted areas and be handled by dealers whose facilities and sanitary practices are certified as meeting specified standards. This is a cooperative program - state, industry and U. S. Public Health Service. This program involves water sampling and sanitary surveys of shellfish producing areas and strong state law enforcement in polluted areas and careful surveillance of shellstock and shucking plants.

An intrastate permit allows shucked clams to be sold within the State if plants and sanitation conform to regulations of the Department. Department bacteriologists and sanitarians work closely with the shellfish industry in aiding in maintaining high standards and upgrading facilities to assure that Maine shellfish can continue to be utilized and produce the much needed food and economic wealth for the State. John Hurst is in charge of this bacteriological program. Field studies are conducted by Edwin Mitchell and Stephen Babine. Lloyd H. Varney, as Marine foods Sanitarian aids the industry in various aspects of quality control and the inspection of shellstock and shucking plants.

Titles of additional projects in recent years

Heavy metal monitoring of shellfish growing areas.

Water quality monitoring of shellfish growing areas.

Oxygen consumption of Mya arenaria at various temperatures in 30 o/oo salinity.

Acclimation of the soft clam, Mya arenaria, to a fluctuating salinity environment.

Mortality of lobster in crowded natural storage areas.

The study of an association between sea water temperature and the relative abundance of certain commercialized marine species.

Water quality criteria for waters to be used for shellfish depuration.
The effect of dumping dredge material from a grossly polluted source
on the shellfish growing area waters of the Lower Kennebec.
Monitoring of seasonal Gonyaulax poisoning in Maine water.

Other Department Activities

Marketing - The Department conducts an extensive marketing campaign for Maine seafood products in areas east of the Mississippi. Four field personnel are at work in this program. Numerous promotional materials are published. The Department participates in ANUGA, an international food exhibit, currently being held in Cologne, Germany. George Taylor is chief of this division and is assisted by Robert Hawkins, Benjamin Tucker, Jr. and Reginald Bouchard.

Publications - Several hundred publications document the work of the marine researchers of the Department. A bibliography is available upon request.

Wetlands Control Board - Commissioner Green is Chairman of this newly established body, charged with the administration of a new law requiring a review and approval of all proposals to alter the State's marine wetlands. Already this has developed into a major activity and will increase in importance as pressures increase to dredge and fill, and otherwise alter and destroy habitat for wildlife, and irrevocably interfere with marine food chains and the flow of nutrients utilized by coastal fish and shellfish.

Lobster Propagation - A lobster propagation program of buying and returning seed lobsters is being carried out, supported in the amount of \$25,000 annually, collected through the licensing of lobster fishermen.

Sardine Processing Research - Working with the Maine Sardine

Council and the Dynatech Corporation, the Department has embarked on a study of a feasibility of mechanizing and modernizing the sardine canning facilities in Maine.

Atlantic Salmon Run - The Atlantic salmon run in the Sheepscot River is due almost entirely to the efforts of Department biologists. It has become one of the principal salmon rivers in Maine, rating second or third in annual production of fish. Based on river size, it produces more salmon per unit than all other Maine rivers.

Maine Department of Inland Fisheries and Game

Augusta

Commissioner Ronald Speers heads this department of Maine government whose oceanographic responsibilities fall mainly in the realm of anadromous fish management and research. Atlantic salmon are the principal subjects, although management of eels and alewives and related species does play some part. Members of Inland Fisheries and Game are employed by the Atlantic Sea-run salmon Commission in Orono and there is departmental financial support not only for this group, but also for the Fisheries Cooperative Unit in Orono. A good number of the departmental personnel, although currently working primarily with fresh water fish, have had experience with marine species.

An important project being carried out by this department is the Atlantic Salmon Restoration in the Penobscot River. Fishway construction and removal of obstructions to fish passage at more than 7 dams has been planned in a program that will cost more than half a million dollars. Fishways at Howland have been completed, construction has begun at Milford and Great Works and will soon begin at Veazie. Remaining to be undertaken will be work at Bangor, West Enfield, Mattakeunk and removal of obstructions in various tributary streams.

Inland Fisheries and Game is also the designated state agency for directing a task force of model river basin planning that will seek to inventory the water resources and conditions of the Penobscot River.

Maine Sardine Council

Augusta - Brewer

The Maine Sardine Council, an industry-supported activity, is headquartered in Augusta, with Richard E. Reed as Executive Secretary. The Maine Sardine Research and Quality Control Laboratory is located in Brewer. There is a large lot, with a one-story laboratory and basement, large storage space and a two-car garage. The principal work carried out at the laboratory is quality control testing of sardine products. Some 10-25 persons work at the laboratory. The position of research director is currently vacant. The responsibilities of the research director are primarily as a trouble shooter in areas of processing, increased mechanization and marketing. Basic research on herring has been left to the U. S. Bureau of Commercial Fisheries with whom the Maine Sardine Council works closely.

U. S. Bureau of Commercial Fisheries

U. S. Department of the Interior

Fish and Wildlife Service

Biological Laboratory and Research Program

West Boothbay Harbor, Maine

The Bureau of Commercial Fisheries maintains a program of marine research located in a complex of biological laboratory facilities at McKown Point, West Boothbay Harbor, Maine.

Eight buildings, among them several residences, comprise the complex. Facilities include a plankton lab, parasitology lab, herring behavior lab, lobster research lab, environment data and statistics storage, extensive biological library and periodical collection containing more than 8,000 items, SCUBA lockers and

technical support space. A large dock accomodates the vessels used in research projects, the 40 foot Phalarope and the 60 foot Rorqual.

The Boothbay Harbor station has been in operation since 1905. In 1948, the principal activity until then the hatchery rearing of lobsters and marine fishes, was discontinued and the accent placed exclusively on research. Studies to develop means of increasing and managing soft shell clam stocks were begun in 1948 and terminated in 1960. From 1954 to 1959, a general ecological study of the habitat of the Atlantic Salmon was conducted in the Sheepscot River. In 1947, the station's first research on Maine sardines (immature herring) began in collaboration with the Maine Department of Sea and Shore Fisheries and the Maine Sardine Packers Association. Studies of mature herring commenced in 1955. They continue to the present day, as does the lobster research program, which started in 1964.

Current efforts in the sardine-herring research conducted by the Boothbay Harbor station are concerned primarily with the questions of why the catch fluctuates and where the fish come from. Activities designed to solve these problems of scarcity and abundance include: (A.) Compiling records of catches, (B.) sampling herring from catches for age, rate of growth, blood type, bone structure, etc., to determine changes in the stocks, (C.) inspecting the young fish in the ocean from time of hatching until adulthood, (D.) examining the food of herring for clues to migration, (E.) studying large offshore herring for their effect on inshore herring and studying the effect of the Russian fishing fleet on herring populations, (F.) exploring physical oceanographic aspects of the Gulf of Maine for their effect on herring,

(G.) studying the behavior of the fish itself, under controlled conditions in the laboratory.

Goals of the Boothbay Harbor station's lobster research program are twofold: (1.) To learn whether the inshore fishery has any connection with the offshore fishery, (2.) To learn what a lobster requires of its environment, so as to determine methods for improving the catch. Organization of the lobster study includes: (A.) keeping records of the catch, primarily the offshore catch, a fishery that extends as far out on the Continental Shelf as 100 miles and where individual lobsters may weigh as much as 30 pounds, (B.) studying the lobsters' movements and devising a tag for lobsters that will stay on after moulting, such a tag is now being field-tested near Monhegan Island, (C.) examining the structure, growth and blood types of lobsters to determine if there are local group differences, (D.) studying of lobster behavior in the natural environment by SCUBA teams, seeking to learn requirements for lobster survival, (E.) studying of lobsters from hatching to adulthood, (F.) studying physical oceanographic effects on lobsters, particularly temperature, salinity, and currents.

The Director of the Boothbay Harbor station, Bernard Skud, is presently on a leave of absence, while studying at Princeton University. Dr. George Ridgeway is the acting laboratory director. The staff numbers 45, of which 20 hold degrees in marine biology or related academic fields. The Boothbay Harbor station acts as a research arm for the Bureau in the International Commission for the Northwest Atlantic Fisheries.

Records of surface water temperature have been kept at the Boothbay Harbor station since 1905. These are the longest and most continuous such records in the United States.

The annual budget of the Boothbay Harbor station is in excess of \$600,000.

ESSA Programs

Environmental Science Services Administration

U. S. Department of Commerce

On November 8, 1967, Governor Kenneth M. Curtis and Dr. Robert M. White, Administrator of the Environmental Science Services Administration, announced the establishment of an Estuarine Flushing and Nontidal Current Prediction Service for Penobscot Bay.

This quarter of a million dollar program is designed to aid Federal, State, County, and Municipal agencies and private industries concerned with water pollution as it affects fisheries, public health, recreation, potable and industrial water, and many other related factors. It will consist of renewal rate prediction advisories issued for each month, approximately two weeks in advance.

The program will begin in the summer of 1968. It will be carried out by ESSA's Coast and Geodetic Survey with the aid of the Weather Bureau of ESSA.

Other Maine estuaries may be added to the program, which will also include a circulatory study of the entire Penobscot River and Bay Estuary, in order to provide more accurate navigational services to yachting, fishing, and commercial shipping interests. The circulatory study will also be conducted by the Coast and Geodetic Survey, using the 133-foot, million and a half dollar ship, Ferrel, currently under construction.

ESSA maintains reference tide stations at Eastport and Portland and predictions are made of tidal behavior at a number of other locations. During September 1967, ESSA scientists carried

out a two-week gravity survey of the sea bed of the Gulf of Maine. Previously, seismic and magnetic surveys had been made of the bottom of the Gulf of Maine, according to Dr. Hyman Oderlin, a Coast Survey geodesist, heading the gravity project. Some Bathymetric maps for the Gulf of Maine have been issued.

ESSA scientists have also conducted tests in the Gulf of Maine of the ability of the ocean floor to support underwater structures. These tests were carried out at a depth of about 885 feet in the Wilkinson Basin, some 60 miles east of Boston. Three unique instruments used to measure sediment strength, bulk density, and water content and pore pressure were employed for the first time.

Marine Colloids, Inc.

Marine Colloids, Inc., is a multi-million dollar company with operations in various parts of the United States and the world. Administrative headquarters are in Springfield, New Jersey, and the principal manufacturing plant and research facilities are in Rockland, Maine. James R. Moss is the President of the company. The Rockland operation is handled by four department heads: Bartholomew Pellicani, Vice President Manufacturing; Sidney D. Upham, Vice President and Director of Research and Technical Development; Nicholas Pellicani, Vice President of Raw Material Procurement; and John S. Koegle, Director of Engineering and Process Development.

The principal activity of Marine Colloids, Inc., is the extraction of polysaccharides, principally carrageenan, from seaweed. There is also minor production of algin and agaragar derivatives. The most extensively used raw material is the red seaweed Chondrus crispus, (commonly known as Irish moss) a native seaweed growing abundantly along the shores of New England, especially Maine, and in

the Maritime Provinces of Canada. Throughout this area Marine Colloids, Inc., owns and directly operates a number of strategically placed harvesting stations. In addition, Marine Colloids, Inc., harvests and imports great quantities of other related species from all corners of the globe, including Africa, South America, the western Pacific, and Europe.

The Rockland operation was established in 1937 under the name of Algin Corporation of America for the purpose of extracting algin from kelp, a brown seaweed. A diversified product line was started in 1949 when Algin Corporation of America began the production of carrageenan from Irish moss. In 1959 this company merged with another manufacturer of carrageenan, Seaplant Chemical Corporation of New Bedford, Massachusetts, to form Marine Colloids, Inc. Subsequently all manufacturing operations were consolidated in the Rockland facility, which has since been expanded to approximately six times its original size in 1959. The company is still experiencing rapid growth.

In Maine, Marine Colloids, Inc., has a total work force of approximately 215, an annual payroll of about 2 million dollars, and figures its total in-state expenditures at more than 4 million dollars. The manufacturing complex in Rockland consists of fourteen buildings on an eleven acre site. There is a field station for collecting and mechanically drying Irish moss at Orr's Island, Maine. The company also owns two additional field stations located at Stonington and Jonesport which it hopes to activate as soon as additional harvesting data is developed for those areas. The company has already persuaded one substantial "satellite" supplier to locate a manufacturing operation near Rockland and hopes to persuade a second supplier to follow suit in the near future.

A research staff of more than forty scientists and technicians work in an extensive laboratory located on the Rockland property. Major ongoing programs include: (1) basic research on the chemical and physical properties of seaweeds which can be harvested in commercial quantities, (2) basic research on the molecular structure of seaweed extractives, (3) evaluating the physical and chemical properties of seaweed polysaccharides with regard to their possible use in foods, pharmaceuticals, cosmetics and industrial applications, (4) research pertaining to the growth and ecology of seaweed beds, (5) investigating the possibilities of growing macro and microalgae under controlled conditions, especially with regard to utilizing the nutrients contained in the ocean water, (6) research on improving methods for harvesting red seaweed, (7) developing improved extractive processes for polysaccharides, (8) research on useful chemicals or medicines that might be extracted from seaweeds or microalgae other than polysaccharides, (9) because carrageenan is highly reactive with proteins, protein chemistry plays an important part in the research and sales aspects of Marine Colloids, Inc. activities. A substantial amount of research is constantly in progress investigating new protein-carrageenan complexes and reactions and finding new possibilities in this area. This activity is leading the company into exploring other seaweed organisms, particularly microalgae as potential protein food sources.

Dr. Sidney Upham, a specialist in organic chemistry, heads up the research and development teams. Five other Ph D.'s with backgrounds in organic chemistry, Dr. George Mueller, Dr. John Koegle, Dr. Donald Renn, Dr. Kenneth Guisely, and Dr. William Thomson work with Dr. Upham along with a supporting staff of specialists in organic and bio-chemistry and engineering. This basic research group is also

supported by a highly competent staff of "application" chemists in Springfield, New Jersey. The laboratory in Springfield is designed and situated to work with customers and prospective customers for the purpose of developing new uses for the products developed by the Rockland basic research group. The Springfield group is composed of specialists in food chemistry and technology, cosmetic and pharmaceutical uses where colloidal products may prove useful, textile printing and paper coating and sizing, and industrial specialists, particularly with regard to suspension systems, abrasives, ceramics, etc.

For some years Marine Colloids, Inc., through a subcontract with Battelle Memorial Institute, has been attempting to develop a mechanical harvester for the gathering of some of the red seaweeds, such as Irish moss. A prototype has been built and is being tested in cooperation with personnel of the Maine Department of Sea and Shore Fisheries. The objective for developing some type of mechanical harvester is to provide a mechanism which will enable fishermen to harvest sufficient Irish moss per day to compete with other industries on a daily wage basis. This is particularly important in countries having a high standard of living, such as the United States and Canada. At a Special Session of the 103rd Maine Legislature, legislation was passed permitting leasing of specialized areas of the coastal sea bottom for the purpose of experimental seaweed harvesting.

The uses of the red seaweed extractives, principally carrageenan, are extremely varied and new uses are constantly being found by Marine Colloids, Inc. Carrageenan is used as a stabilizer in ice cream, lends richness and stability to whipped cream, contributes body and flavor stability to fruit syrups, relishes, and pickles.

It is the principal thickening agent in toothpaste and is also added to cake mixes to maintain consistency and promote fine texture. It is an ingredient in various cosmetic and pharmaceutical preparations, particularly where thickening, suspending, gelling or film forming functions are desired. One of the fastest growing areas is dessert gels where it acts as the principal gelling ingredient. Its ability to suspend is unique, which makes it a valuable commercial product in the suspension of chocolate milk or abrasives. It is finding increasing use in baby foods, cake icings for emulsion stability, etc. The list of Marine Colloids, Inc. customers reads like a who's who among national food processors, toothpaste manufacturers, pharmaceutical and industrial firms. Carrageenan, which derives its name from Ireland's County Carragheen, where moss has been harvested for centuries, has potential uses wherever gelling, suspending, thickening, bodying or film forming is indicated.

The company is presently manufacturing a highly sophisticated agarose and agar beads which will find increasing use as a research tool for the food and pharmaceutical industries. At an appropriate future date the company also plans to start the manufacture of agar-agar. High purity algin products have also been manufactured by this organization for many years and expansion with this particular product is also planned for the near future.

The Mount Desert Island Biological Laboratory

Salisbury Cove, Maine

The Mount Desert Island Biological Laboratory is an independent marine biological station, operating during the summer, in which extensive research, mostly on physiological problems, is done with the local flora and fauna of Maine waters as experimental material.

Basic laboratory space exists for 27 research programs. During 1966, the last year for which figures were available, there were 63 scientific personnel in 29 research groups representing 22 institutions in 16 states. No formal courses are offered, but some advanced undergraduate, graduate, and medical students work as assistants to senior investigators.

The Laboratory was founded in 1898 and moved to its present location in 1921. It is a nonprofit scientific and educational institution with, at present, some 260 members of its corporation. Dr. Charles E. Wilde, School of Dental Medicine, University of Pennsylvania, is the current Director.

The Laboratory has pending an application before the National Science Foundation an application to expand and rehabilitate its physical plant. This would involve the construction of 30 new laboratory modules with service buildings and dock. Efforts will be made, as part of this 3 million dollar plan, to operate the facilities more continuously.

In addition to six separate laboratory buildings, there is an instrument room, housing such equipment as a refrigerated centrifuge (Internation PR2), Warburg apparatus (circular), Beckman spectrophotometer DU, etc., a biophysics building, housing isotope counting systems, ultracentrifuges, etc., a library and numerous other support buildings, including dining hall, auditorium, dormitory, and family cottages. A 32-foot power boat, the Squalus, is used for collecting and the Laboratory dock contains live cars for storage of specimens.

Examples of types of research taken from the annually published Bulletin of abstracts includes investigations such as "Pseudocholesterase Activity in the Dogfish, Squalus acanthias", "Invertebrate

Defense Systems", "Ecology of the Acorn Barnacle, Balanus balanoides".

Northeastern Research Foundation, Inc.

Brunswick, Maine

The Northeastern Research Foundation was established in the late 1950's to provide for more effective use of scientific, technical engineering and other professional talents in meeting problems confronting Maine and contiguous areas. Membership includes representatives from most Maine institutions of higher learning, from state government agencies and from the business community. Current President of NRF is Robert L. Dow, Director of Marine Research, of the Maine Department of Sea and Shore Fisheries.

Through its membership NRF is able to bring together under contract professional research teams capable of addressing problems in a variety of research fields. Although NRF has not prepared any specific reports dealing with oceanographic matters, the membership includes several biologists and marine scientists, geologists interested in coastal problems and economists concerned with development of marine resources. The Foundation has in the past prepared proposals related to the development of Maine's coastal environment.

Ocean Research Corporation

Ocean Research Corporation of Kennebunk, Maine is a subsidiary of Bio Dynamics, Inc., of Cambridge, Massachusetts. Cyrus Hamlin of Kennebunk is the President of ORC. Mr. Hamlin is a naval architect of 30 years experience, a former fellow at the Stevens Towing Tank, Hoboken, New Jersey, whose research interests are in hydrodynamics of hulls, fishing gear and methods, fishing vessel design and catamaran configuration for seagoing working platforms, on which he has published several papers. Work in progress at ORC includes:

(A.) design of a 75-foot Hudson River Sloop as a floating museum, duplicating the original sloops of 100 years ago, (B.) design of two 34-foot catamarans, one for West Coast fishing interests, the other for research work by a Pennsylvania college in Delaware Bay, (C.) parametric study of an optimum fishing vessel for Georges Bank, being funded by the U. S. Bureau of Commercial Fisheries, (D.) study of fishing vessel construction costs in the U. S. and selected foreign countries, also being funded by the U. S. Bureau of Commercial Fisheries.

The Jackson Laboratory

Bar Harbor, Maine

The Jackson Laboratory is a world-famous center for medical research and for the raising of experimental animals, notably mice. "Jax" mice, as they are called, are in the words of one scientist, "the Rolls-Royce of the lab mice". Carefully inbred to reduce genetic variations, they serve as scientific models of human disease. The bulk of the research carried on at the Jackson Laboratory is in the area of genetics as it effects human disease, such as in cancer or diabetes.

The Jackson Laboratory carries on no marine research as such. However, two members of the staff have had backgrounds in marine science. Dr. John Fuller has been a summer fellow with the Woods Hole Oceanographic Institution, has worked with the Fish and Game Departments of New Hampshire and Maine and has a research interest in nutritional cycles in the sea and biological resource surveys. Dr. Wesley K. Whitten, whose research interests are in reproduction and embryology, has participated in studies of elephant seals in Antarctica.

RAMP Project

Regional Academic Marine Program

Traip Academy

Kittery, Maine

The Regional Academic Marine Program is funded by a grant from the U. S. Department of Education under Title III of the Elementary and Secondary School Education Act. Traip Academy is the public high school in Kittery. The director of the program is Sebastian J. Cultrera, a teacher of biology at Traip.

The original conception of the RAMP project was for a regional facility to be centered in Kittery that would serve to train elementary and secondary school students from the entire Maine-New Hampshire Seacoast Region in marine biology and related subjects. Part of the original plan was also for a public aquarium.

Because the present grant under Title III has been limited to \$31,181, the program itself has been presently limited to a local basis and is being conducted as a pilot project.

The program was formally initiated on January 1, 1968, and will run on its present basis until December 31, 1968. The RAMP Research Center is located in the former Austin School, where alterations have been made for administrative space and for the beginning of an aquarium-reference room. Classroom units are now being prepared for grades six to ten and plans made to continue a summer secondary marine biology course for credit, previously inaugurated under a Title III planning grant. A day camp type of class for upper elementary grades is also being discussed as a possibility. Three advisory committees have already been formed to augment the project, composed respectively of Kittery administrators and Maine colleges marine specialists, Kittery teachers, and local citizens.

Twelve students are now being chosen for the six-week summer course in marine biology. The advanced course is for students who have completed one year of laboratory biology. Two weeks will be devoted to marine ecology, two weeks to marine algae, and two weeks to marine invertebrates. The Maine Department of Education has approved the course for one credit toward graduation.

Initial experience has already been gained through the exposure of more than 50 sixth graders to the first of the units developed which is the setting up of an aquarium for local echinoderms. In all, some 160 sixth graders will be exposed to this unit.

Plans have been formulated for an Adult Series, to consist of lectures by authorities on various marine organisms, plus films and an adult field trip.

Yarmouth High School Marine Curriculum Development Program

Yarmouth High School

Yarmouth

A planning grant of \$22,790 under Title III of the Elementary and Secondary School Education Act has been given to Yarmouth High School for the development of marine curricula. The project is directed by John Wibby, Physics and Mathematics Instructor and Science Coordinator. A staff of seven, including one teacher from Deering High School in Portland, has been assembled to begin work on the project. Initial activities will focus on training of the staff to write marine curricula. Late in June 1968, they will go to Narragansett, Rhode Island, and spend five weeks studying under Dr. John P. Conover, Director of Oceanography Education, at the University of Rhode Island. Returning to Maine, the group will work throughout the rest of the summer in writing marine curricula for the Yarmouth school system. These curricula will then be tested

during the regular year with a regular summer program for more than 30 students being instituted the following year. A potential laboratory facility has been offered to the program by the Central Maine Power Company on the site of its Cousins Island power plant operation. Mr. Wibby intends to apply for an operational Title III grant to support the educational activities that are evolved, the renovation of the laboratory facilities and the purchasing of a small boat for collecting and research purposes.

Cornell University Summer Marine Biology Program

Isles of Shoals

Cornell University, under Dr. John M. Kingsbury, Associate Professor of Botany, has been running a summer program in marine biology on the Isles of Shoals, a set of mostly uninhabited islands off the coast of southern Maine and New Hampshire. Until now, the program has been operated on Star Island, which is in the State of New Hampshire, but University authorities in Ithaca have shown interest in establishing more permanent facilities on Appledore Island, which belongs to the State of Maine as part of the town of Kittery. Contemplated is the rehabilitation of the former marine station of the University of New Hampshire on Appledore. On Star, the Cornell summer contingent of about 30 students and 6 professors operates through facilities provided by the Star Island Corporation, owners of a large hotel on the island. A large laboratory room with tanks, aquaria, sea table, and running sea water is provided. The purpose of the program is to introduce students through lectures, field work, and laboratory exercises to the major disciplines of marine biology and to allow students who have studied marine science at an inland location an opportunity to work first-hand in an unspoiled ocean environment.

Suffolk University Summer Marine Research Station

Suffolk University of Boston, Massachusetts, has for several years past conducted courses in Marine Invertebrate zoology. As part of a summer program, students have been taken to the Moosehorn Wildlife Refuge in the Bay of Fundy region of Maine. From headquarters within the park area of the Refuge, daily collecting trips have been made to various types of nearby marine habitat.

Because of the limitations inherent in this experience, Suffolk University is now seeking a permanent shorefront site in the general Cobscook Bay district, which is in extreme northeast Maine. Several sites are being considered. At the same time, Suffolk University has acquired a 45-foot house trailer that is being renovated into a mobile laboratory and classroom. It will be based at whatever northern Washington County site is acquired by the University and will be made available to other interested groups within the State of Maine. Director of the project is Dr. Arthur J. West II, Professor of Biology and Co-Chairman of the Biology Department at Suffolk University.

Maine Maritime Academy

Castine

The Maine Maritime Academy trains Merchant Marine officers. Each year, approximately 100 commissioned deck and engineering officers are graduated. The Academy operates a large vessel, the State of Maine, on which oceanic training cruises are undertaken. Several small craft are also owned. Admiral E. A. Rodgers, Superintendent, has expressed a strong interest in the Academy's participation in oceanographic activities and there have been some discussions with the University of Maine about possible joint programs. Admiral Rodgers himself, has had experience as commander of the Naval Air Experimental

group, in working with Woods Hole. Other personnel, as part of their seagoing backgrounds, have had experience in fields useful to oceanography. Eugene Spinazola, Instructor in the Engineering Department, has studied marine life as a SCUBA diver and has explored various parts of Penobscot Bay for historical finds.

Farmington State College

Farmington

Three members of the staff at Farmington State College have interest in marine science. Dr. Robert Thurston, interested in water chemistry, has been a visiting research associate with the Department of Oceanography at the University of Washington. Associate Professor Robert L. Martin has conducted marine invertebrate studies at the University of Washington's Friday Harbor Labs and he is interested in aquatic mammals and aquatic invertebrates. Assistant Professor Charles Chakoumakos is an analytical chemist with an interest in oceanography.

Industrial and Miscellaneous

Vocaline Company of America

South Bristol - West Bath - Waldoboro

The Vocaline Company, headquartered in Old Saybrook, Connecticut, is largely a producer of synchronous motors and timers, but now derives more than 25% of its sales from oceanographic operations.

A major showcase for Vocaline is the underwater research vessel, Bittern MHC-43. It has been refitted with electronic equipment that enables it to do quality control analysis of antisubmarine devices.

In Maine, Vocaline has several installations. At South Bristol, it is operating a major sonobuoy testing range for the U. S. Navy. A complete Navy testing facility on the site, along with several

vessels, have been turned over to the company, which operates its tests supported by aircraft and equipment from the Brunswick Naval Air Station. Heavy emphasis is on the use of sonobuoys as an anti-submarine warfare device. Vocaline is testing other anti-submarine warfare devices, as well. Much of its work is classified.

Vocaline has acquired another testing facility at West Bath, where it will conduct tests for the Naval Air Systems Command. This facility is a former radar tower that was run by an M.I.T. laboratory. It is a large hexagonal tower that is to be used to test cables. The company is building a 58-foot tank inside the legs of the tower. Cables are to be lowered into the tank in the same manner that a helicopter would for the sonar detection of submarines.

At the Vocaline research and development center in Waldoboro, a wave height indicator has been designed. Electric Boat (General Dynamics) and the Naval Air Systems Command have ordered quantities of this device.

Other Vocaline Maine projects include: testing explosive charges at sea, a study of surface and subsurface currents in the Gulf of Maine utilizing a surface drift bottle and seabed drifter, a study of meteorological conditions in the Gulf of Maine, and engineering tests in river areas along the coast of Maine. In Maine, Vocaline operates two Navy vessels of 65 feet and 144 feet and one private vessel of 43 feet.

Recently, Vocaline announced intentions to increase its operations in Maine.

Heading up Vocaline's oceanographic section and its efforts in Maine is Larry A. Cole, oceanography and engineering mechanics graduate of the University of Michigan. Cole's research interests

are in experimental hydrodynamics, underwater acoustics, military and physical oceanography, air-sea interaction, wave studies, thermal pollution, water resources and sub-surface current studies.

Sanders Associates

South Portland

Sanders Associates, a rapidly growing firm specializing in the creation and production of electronic systems, has its parent organization located in Nashua, New Hampshire. The company employs some 5,800 people, among them 1,225 engineers. Its current programs include major anti-submarine warfare buoy systems, submarine communications systems, ocean surveillance systems, electronic counter measures equipment, ASWEPS deep-moored buoys, shipboard direction finding systems, and other systems not directly related to oceanography. Ocean systems facilities for research and development are located in Nashua and the company operates an ocean test range off Portsmouth, New Hampshire and others off Long Island, New York, Bermuda, and Nassau, Bahamas.

The South Portland operation is almost exclusively for the manufacturing of ocean systems, including sonobuoys, the Mark 84 Signal Device for sound source, aircraft equipment for anti-submarine warfare, and other advanced instrumentation. The South Portland plant has floor space of 47,000 square feet and cost more than half a million dollars to build. Initial hiring was of 150 employees, but plans call for a doubling of floor space in the near future and a jump of employment to 425.

Portsmouth Naval Shipyard

Kittery

The Portsmouth Naval Shipyard, located entirely in Kittery, Maine, is one of the largest industries north of Boston, employing

approximately 8,200. The Shipyard has the capability of building, overhauling, and repairing atomic-powered, missile-firing submarines. The annual payroll amounts to more than 56 million dollars. About 3,300 of the Shipyard workers live in Maine.

Three new submarines are being built at the yard and three submarines are undergoing a major overhaul.

Of oceanographic interest is one of the three new submarines under construction, the Shipyard--designed experimental deep-diving submarine AGSS555 (Dolphin). It is expected that the Dolphin will be used by the Navy for oceanographic work after the completion of the first two phases of its mission, general engineering test research and sonar research.

More than 1,200 engineers and technicians are employed at the Shipyard. The total plant value exceeds 78 million dollars.

Bath Iron Works

Bath

The Bath Iron Works, currently employing 3,500 workers, is a modern 65-acre shipyard, with side plants for the production of missile-carrying destroyers, escorts, and frigates and merchant ships, specializing in container cargoes, as well as Anti-Submarine Warfare hardware and systems, industrial and heavy marine equipment, and fabrication, and exploitation of advanced technologies and disciplines.

Five building ways (600 x 100 feet), outfitting piers, large modern shops for machining, pipe fabrication, high pressure boiler assembly, sheet metal, electrical, electronics, steel fabrication, galvanizing, large structural assemblies, woodworking, pattern making, etc., are some of the existing capabilities. There are building and

outfitting gantries. There are chemical, physical, and metallurgical labs. The normal work force is complemented by more than 60 marine engineers and 120 draftsmen and a further staff of designers, naval architects and technical specialists.

Bath Iron Works, which recently became part of a larger, diversified, holding company called Bath Industries, has built the only warships ever manufactured in the United States for a German Government, three guided missile destroyers for the West German Navy. Two of the three are now completed.

Bath has a bow dock available for the installation of sonar equipment on destroyer type vessels and work on bow observation ports in oceanographic ships. A 680-foot pier with a travelling 90-ton crane would be available for major repair work.

Hyde Windlass, a subsidiary of Bath, manufactures all types of winches for ocean-going vessels and a wide variety of deck machinery. It also produces distillation systems for ships and has subcontracted for submarine parts.

Bath has an active interest in oceanography. President James Goodrich has served as Maine Chairman of the Bi-State Commission on Oceanography. Public Relations Director, William Haggett, is a member of the Governor's Task Force on Oceanography.

Oil Exploration

During 1967, oil exploration was carried out for the first time in history in the Gulf of Maine. The Gulf of Maine quest was a cooperative venture by eight oil firms headed by Chevron Oil Company's California Company Division (Calco) based in New Orleans. Among the other companies participating were Continental, Gulf, Humble, Mobil, Pan American and Union Oil of California. Bruce Ganek of Calco was

in charge of the operation. The survey work was carried out by the Ray Geophysical Division of Mandrel Industries, Inc., Houston, Texas, using a 165-foot vessel, the State Arrow, carrying 12 crew members.

The nonexplosive seismic technique called "vibroseis" was used throughout the survey in order to avoid any possible damage to fish and other living marine resources. Vibroseis works through vibrator units that are suspended from the side of the ship. Some of the exploration was carried out in the Georges Bank area, a well-known fishing ground. Results of the survey have not been released, but it is generally expected that further exploration is to be announced for 1968.

Maine Port Authority

Portland

The Maine Port Authority is the State of Maine agency charged with responsibility for developing and administering port activity and water borne transportation. The Authority, under its Director Edward Langlois, operates the Maine State Pier in Portland and numerous other State piers in connection with State-owned ferry service to islands in Casco Bay and Penobscot Bay. There is also a year-round ferry service between Bar Harbor and Yarmouth, Nova Scotia.

With Mr. Langlois as Chairman, a site-selection committee was appointed in 1966 to evaluate oceanographic sites offered to a proposed ESSA East Coast headquarters for its marine activities. The choice later went to Miami, Florida, but numerous locations with a potential for oceanographic development were revealed to exist in Maine. The four sites selected by the Committee for final presentation were the former Dead Duck Inn property in Eliot, the South

Portland Naval Reserve Training Center property, available property at the U. S. Navy's Harpswell Fuel Depot, and the Darling Center in Walpole. Additional locations were offered in Boothbay Harbor, Kittery, East Boothbay, Cape Elizabeth (Fort Williams), Great Diamond Island, Long Island, Rockport, Rockland, Searsport, South Portland (SMVTI), Stonington, and Westport.

Gamage Shipyard

South Bristol

The Hero

The Hero is perhaps unique as an oceanographic vessel. Wooden-hulled and two-masted, she is a far cry from the usual image of a sleek, high-powered scientific research ship. The National Science Foundation had her especially built for Arctic and Antarctic research at a cost of more than a million dollars. Her heartwood planking, sheathed with steel, is designed to withstand ice jam pressure. She will have a cruising range of 5,000 miles and carry twin diesels of 380 horsepower each. The sails are in case of mechanical failure. Among her gear will be a small laboratory for scientific study and refrigeration equipment to permit freezing of ocean specimens. Her first and probably only duty station will be at a base on the Bellinghausen Sea, where she will be used to probe the ocean depths and floor with electronic and mechanical gear designed to make observations as far as 12,000 feet below the surface. A shakedown cruise to the Labrador Sea will carry several scientists from the University of Maine, among them Dr. David Dean and Dr. John Dearborn.

The Gamage Shipyard specializes in heavy wooden fishing vessels and other custom craft requiring heavy wood construction. The shipyard has recently built the Shenandoah, a replica of an 1845

revenue cutter, now in service as a tourist ship at Martha's Vineyard Island, Massachusetts. The Mary Day, a windjammer cruise ship out of Camden, Maine, was also built at the Gamage yard. The Hero is 125 feet in length, 116 feet at the waterline, constructed of oak, has a 30-foot 4-inch beam and 1,721 square feet of sail area.

Kraft Foods

South Portland

A division of National Dairy Products, Kraft Foods at South Portland manufactures carrageenan out of Irish moss in an operation similar to that of Marine Colloids, Inc., Rockland. These two plants are the only ones on the East Coast manufacturing extracts from seaweed. Kraft has only a small scale pilot plant, however, employing 50-55 people. Approximately 15% of its seaweed raw material comes from Maine, the rest coming from the Maritime Provinces. All research is done at the company's major research facility at Glenview, Illinois. With the exception of Sealtest Ice Cream, another division of National Dairy Products, most customers for Kraft carrageenan are not connected with National Dairy Products. The finished material is used for ice cream stabilizers, instant milk shakes, stabilized chocolate powder. The research done at Glenview is into possible new uses for carrageenan.

Mearl Corporation

Eastport

The Mearl Corporation, with headquarters in Ossining, New York, is engaged in manufacturing industrial products from fish, primarily herring. One researcher, Robert Gardner, graduate chemist, works year-round in Eastport on problems of quality control. At Ossining,

in extensive laboratories, some 50 scientists are at work, including 15 PhD.'s. In the summer, a number of these scientists work in Eastport.

Products manufactured by Mearl include fish meal, fish oil, fish solubles, and mechanical air foam, which is used for putting out fires. Pearl essence is made at Mearl from fish scales and the bellies of small herring. There are 15-20 buildings and 75-80 employees

Some research has been done into Marine Protein Concentrate, but Mearl feels it cannot undertake operations in this area until herring are approved as a raw material. Whiting, the only approved fish now, is too expensive, they feel. A good deal of the product of the Mearl plant is sold abroad. The herring used are caught within a radius of 50 or 60 miles, mostly by Canadian fishermen.

Seafair, Inc.

Sebasco Estates, Maine

Seafair, Inc., was founded with the idea of cleaning up and marketing soft shell clams, Mya arenaria, from moderately polluted beds in the Lower Kennebec River. These clam flats had been closed for varying periods from up to 20 years. Previously they had been among the highest producing clam flats in the State of Maine.

Financial assistance provided by the Federal Economic Development Administration through the Maine Department of Sea and Shore Fisheries had made it possible for the Department to do the Basic research for development of a pilot clam depuration plant. The process involves the sterilization of sea water by ultraviolet light irradiation, the sterile water then being passed through tanks in which polluted shellfish are placed. The clams, through siphon action, cleanse themselves.

The USPHS reviewed research data and industry controls developed by the Sea and Shore Fisheries Department and gave approval to the State to authorize plants to be established under close Department supervision. The first commercial depuration plant in the country with this type of water treatment was established by Allen MacGregor, a Yale graduate with an interest in the sea and aquaculture. Modifications were made to the prototype plant and a facility was built and put into operation. The plant and its products were certified by the State under the National Shellfish Certification Program for interstate commerce. This is a federal-state-industry cooperative quality control program. After initial marketing problems were solved, problems of supply developed and MacGregor began to search for means of increasing the local clam harvest. Maine law provides that clams must be dug by hand, except by municipal option in Hancock County and in the town of Phippsburg, where Seafair is located. MacGregor was instrumental in securing the passage of permission for mechanical harvesting in the Phippsburg area. Efforts to adapt a Canadian designed dredge led to failure and MacGregor is now in the process of modifying a Maryland clam dredge to work under Maine conditions.

Marine Biological Supply and Development Corporation

Brunswick - Harpswell

This company, which processes Maine shrimp, also specializes in supplying marine biological specimens to research outlets. A new shrimp processing plant, containing one shrimp peeling machine, has been built. Shrimp, cooked whole in the shell and dyed, are shipped to Sweden. Peeled shrimp are sold here.

Biological specimens have been sent recently to the Retina

Foundation in Boston, to the Harvard Medical School, to Harvard University, Boston University, Dartmouth College, the Massachusetts General Hospital, the Health Research Center in Buffalo, New York, and Cornell University.

Species have included dogfish, the waved whelk, lobsters, rock crabs, green crabs, and starfish.

In an attempt to begin a new fishery in Maine for several species of giant spider crabs similar to the Alaskan King Crab, special traps have been designed and are being built.

Guy Johnson, former teacher and participant in the Bowdoin College summer Marine Biology institute, is the President of the Company. Henry L. Bird, formerly a teacher of biology, is in charge of the animal collecting program.

Underseas Research Vehicles, Inc.

South Thomaston

Captain George Kittredge, U.S.N. (Ret.) is the President of the above company and a companion company, Kittredge Sport Subs, Inc. Captain Kittredge, an electrical engineering graduate of Annapolis, is a former commanding officer of U. S. Navy submarines and a U. S. Navy submarine division. He has built a demonstration one-man submarine that is available for bottom surveys or marine observation down to 250 feet test depth.

Miscellaneous Firms Dealing with Seafood Products

There are innumerable businesses in Maine that deal with products harvested from the sea. Some are large enough or unique enough to merit special mention.

Jasper Wyman & Son, Milbridge, employs 75 people. They have

their own fishermen and are engaged in sardine canning and digging of clams. They are doing some research on herring populations in the Gulf of Maine.

Look Co., Jonesport, is a wholesale lobster company. Owners Bert Look II and Bert Look III have invested in land and in planning preparations for a Maine Marine World aquarium tourist attraction in the Whiting area.

Forty Fathoms Fisheries, Rockland, owns seven trawlers and employs 300 people. They fish primarily off Georges Bank for ocean perch and also import haddock for processing.

F. T. O'Hara and Sons, Rockland, are producers and processors primarily of ocean perch and shrimp. They have four new boats and employ 90 people.

Snow's, Pine Point, Scarborough, a subsidiary of Borden's, cans clams into chowders and other products. About 100 are employed.

Dead River Co., Bangor, the second largest company headquartered in Maine, has a large wholesale lobster business.

Saltwater Farm, York Harbor (formerly of Damariscotta), is a well-known mail-order house for air-freighting lobsters around the country and the world. It also markets canned seafood products under its own label.

Among the largest sardine canners are Seaborad Packing Co., Prospect Harbor; Booth Fisheries, Lubec; Addison Packing Co., Southwest Harbor; Ray L. Packing Co., Millbridge; and B. H. Wilson Fisheries, Eastport.

Miscellaneous Industrial Research and Other Interests

O. P. Peterson Brass Co., Portland, has been a pioneer in propellor manufacture and is interested in marine hardware. It

employs 20-25 people, and is engaged in a venture with A. S. Black Co. in the development of Clam Cove Harbor, Rockport, a deep water port site that has oceanographic possibilities.

National Cylinder Gas Co., Saco, specializes in cylinder gas and has research and development into the supplying of breathing air to divers and developing techniques for the use of helium oxygen at great depths.

Danforth/White Co., Portland, employs 60 and makes marine equipment and oceanographic instruments, anchors, compasses, depth sounders, weather instruments, water speed devices, water distance, Marine audio hailing equipment, marine searchlights. It is a division of the Eastern Co.

General Dynamics Corp., Liquid Carbonics Division, Lewiston, manufactures oxygen and hydrogen for underwater divers and is also concerned with hydrogen's application to electronics.

Hanna Associates, Rockport, is the one-man firm of J. S. Hanna, who makes scale architectural marine models that are world famous. The Smithsonian Institute is a principal client. The models sell for about 3,000 dollars each.

U. S. Navy Satellite Tracking Station, Winter Harbor, came into prominence with the announcement at the Bowdoin oceanographic conference by Vice President Hubert Humphrey that the U. S. Government would release the Navy's pinpoint satellite navigational TRANSIT system to commercial and oceanographic shipping.

South Portland Engineering Co., recently sold its facilities to the General Electric Company. It had been engaged in building a 155-foot fishery research vessel for the U. S. Department of the Interior.

Goudy and Stephens, East Boothbay, recently completed the 103-foot replica of the yacht America for the Schaeffer Brewing Company. This yard is one of the largest among dozens of private boat builders in Maine.

Numerous ship chandlers exist in the Portland area. The Harris Co. is among the largest. There are also several other companies specializing in ship repairs.

Thurston Aircraft Corporation, Sanford, has done research for the U. S. Navy and is developing equipment for seaplanes and water borne vehicles.

Gorham Research Laboratories, Gorham, conducts industrial research for clients particularly in areas of chemical engineering and is capable of doing oceanographic research.

Oceanology Explorer Scouts, York, is a Scout troop devoted to the study of the marine environment. They are working with Dr. Johnstone of Masson College.

Maine Citizens Oceanology Alliance, Brunswick, is a citizens group formed to promote interest in oceanography. Albert G. Hopkins of Brunswick is the Director.

Applied Oceanics, Freeport, is a newly formed research outfit that includes Vocaline oceanographer Larry Cole and marine biologist, Harold Arndt.

